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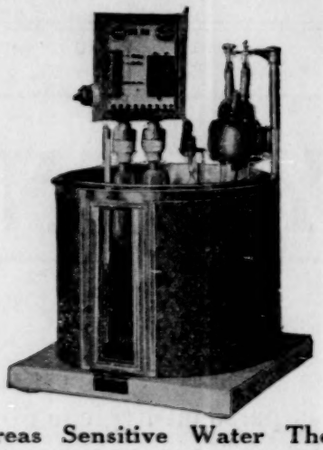

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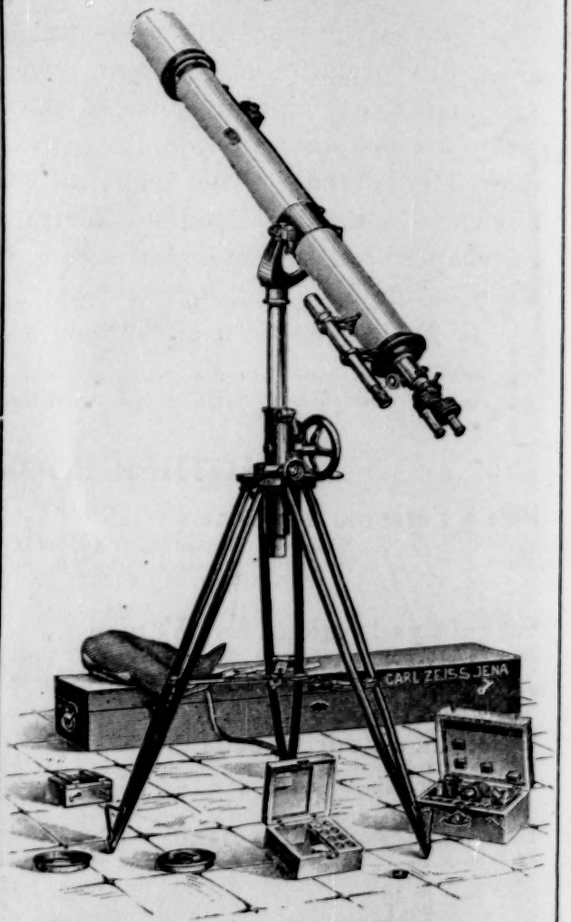

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A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

11 Liberty St., Utica, N. Y. Garrison, N. Y.
New York City: Grand Central Terminal

Annual Subscription, $6.00 Single Copies, 15 Cts.

Entered as second-class matter January 21, 1922, at the Post Office at Utica, N. Y., Under the Act of March 3, 1879.

VOL. LVI SEPTEMBER 1, 1922 No. 1444

CONTENTS

The Geological Survey of China: H. T. CHANG 233

Agglutination and Tissue Formation: DR. LEO LOEB 237

The Shenandoah Caves 240

The Salt Lake City Meeting: W. W. SARGEANT 241

Scientific Events:
The International Research Council; Association of Iron and Steel Flectrical Engineers; The American Electrochemical Society; The Biology Club of the Ohio State University; The Gorgas Memorial 243

Scientific Notes and News 246

University and Educational Notes 249

Discussion and Correspondence:
Meteorite Hunting: PROFESSOR ARTHUR M. MILLER. *The Occurrence in the Atlantic Ocean of the Whale Shark:* DR. E. W. GUDGER. *Discharge of Static Electricity:* H. E. JAQUES. *Paraffine Paper Screen for showing the Position of the Retinal Image:* DR. GEO. D. SHAFER 249

Quotations:
Spirit Photographs 253

Scientific Books:
Manson on the Evolution of Climates: DR. F. H. KNOWLTON 254

Special Articles:
Recent Discoveries of the Antiquity of Man: DR. HENRY FAIRFIELD OSBORN and DR. CHESTER A. REEDS. *Acute Parathyroid Tetany:* DR. ARNO B. LUCKHARDT and J. BLUMENSTOCK. *The Algebraic Method of Balancing a Chemical Equation:* DR. HARRY A. CURTIS 256

The Iowa Academy of Science: DR. JAMES H. LEES 260

THE GEOLOGICAL SURVEY OF CHINA

IN the process of reconstruction, and adaptation to modern conditions, which China is at present undergoing, the introduction of scientific research and, concurrently, the establishment of scientific government organs is absolutely essential to the success of the movement. To a narrow circle of interested mining men and scientists, it has long been known that the Geological Survey of China, established in 1916, has been making steady progress, both in the way of supporting the mining industry with expert advice, and in accumulating scientific data and material to such an extent that it has been recognized abroad as a factor in inaugural ceremonies by and in the presence ploration of the earth.

But the work of the Geological Survey has been carried on in quite an unostentatious way, and little has transpired about its activities outside of professional circles, until July seventeenth, when the institution was officially thrown open to the public, with appropriate inaugural ceremonies by and in the presence of H. R. President Li Yuan Hung.

Before giving an account of these exercises, it may be well briefly to review the development of the survey and its achievement up to the present time.

Geological Government Surveys have been established during the last half century in all civilized states. The principal aims of those institutions are threefold: namely, (1) to promote the knowledge of the mineral resources of the country, (2) to carry on a general geologic survey of the whole country upon a uniform scale, and (3) to undertake scientific geological research.

In the first of these fields the Geological Survey of China can already point to a creditable series of achievements, such as the discovery and survey of a large number of iron-

ore deposits, which will soon be described in a monographic report, and the examination of numerous coal-fields, as well as metalliferous deposits. Among the latter are the antimony and mercury deposits, which have already been described in the bulletins issued by the survey.

The general geological survey of the country has so far been restricted to the province of Chihli, Shantung, Shansi, Bonan, and Kiangsu, the larger part of those provinces being already mapped. It is the intention of the survey to publish sheet maps of the whole of China upon the scale of one to one million, and four such sheets are now in preparation.

The scientific work of the survey has been confined principally to the study and description of the fossil remains occurring in the various geological systems, and to the determination of stratigraphic horizons. The survey has had the advantage of the cooperation of a famous paleontologist, Dr. A. W. Grabau, formerly professor of paleontology at Columbia University, who has made great progress in describing the invertebrate fossils.

A number of Swedish scientists, acting as associate paleontologists to the survey, have, with the Swedish fund, made extensive collections of fossil plants, fossil mammals and the remains of prehistoric man, and these are now being studied by them. The results of these studies, together with Dr. Grabau's investigations on the invertebrate fossils, will be published in "the Paleontologic Sinica," a series of monographs, which is intended to comprise, as far as possible, descriptions and illustrations of all the fossils of China.

Early in the history of the survey, the collections brought together by the field geologists, were arranged to form a small museum. This has grown constantly, until now it comprises 3,250 specimens of ores, minerals, rocks and fossils, properly labeled and exhibited under glass, in the compound of the Survey west city, Fong Shong Hutung, No. 3.

In order to bring together an up-to-date geological library, the director of the survey, Dr. V. K. Ting, approached private individuals as well as mining companies, requesting them to contribute to a library fund. Through their generous response, forty thousand dollars were collected, and with this fund Dr. Ting has been able to erect a modern library building and bring together a collection of geological literature comprising at present 8,873 volumes. President Li Yuan Hung has taken a leading rôle among the individual donators, while among the mining companies the Kailan Mining Administration stands foremost through the generosity of its donation.

It has been considered by the minister of agriculture and commerce, and by the director of the Geological Survey, that this institution has now reached such a stage of development that it is appropriate to throw the museum and the library open to the public. The opening ceremony took place on the seventeenth instant at four o'clock in the afternoon, in the lecture hall of the survey, and in the presence of a distinguished gathering of Chinese officials, headed by President Li Yuan Hung, who, himself a leading donor to the library fund, gave, by his presence, renewed evidence of his scientific interest and democratic spirit. Among other notable guests, we may specially mention the minister and vice-minister of agriculture and commerce, Their Excellencies Chang Kuo Kan and Chiang Tion To; the chiefs of the different departments of the ministry of agriculture and commerce; and delegates from other government museums in Peking, as well as many of the donators and other representatives of the mining industry.

The guests were welcomed by the director of the survey, Dr. Ting, in the following words:

"H. E. the President, Their Excellencies, the Minister and the Vice-Minister, our honored guests and my colleagues: It is my great privilege and pleasure to welcome you most heartily on behalf of the Geological Survey. First of all, I must thank the president, not only because he condescends to come to this ceremony, but also because he is one of the contributors to our building fund. In foreign countries it is not uncommon for the official head of the state to be present at the opening of a similar scientific institution, but, as far as I know, this is the first time in China that the President of the Republic honors such an occasion by his presence. This indicates the scientific interest as well as the democratic spirit of our president, for which we are sincerely grateful.

"Secondly, I must thank the donors to our

building fund. Without their generous help we would be still without a library. Furthermore they have come here to-day in spite of this very hot weather, so that we may have an opportunity to thank them publicly, and to show them what we have done with their money. It proves the real interest they take in our institution. I may add that this is also the first time that private generosity has helped a scientific institution belonging to the government.

"Thirdly, I must thank my official superiors in the ministry of agriculture and commerce. In spite of the political changes that have taken place, they have always given us their support. They have not only provided us with sufficient funds in the time of great financial stringency, but they have also left to their responsible subordinate a great deal of freedom in administration, and in the appointment of the staff. Thus, with the exception of three men in charge of the business part of the institution, practically all the members are technical men. Again there is not a single extra man appointed beside the regular members, whose number is determined by the rules of the organization. Whatever result we have been able to achieve is entirely due to the confidence and guidance of our superiors.

"Fourthly, I take this occasion to thank the members of my staff for their loyal cooperation. Because of the smallness of the staff, we are not able to put men solely in charge of the library and the museum. Practically every member has done his part, in order to render this opening possible. During this summer all have worked, through all the day, instead of only half a day, as in most of the government bureaus, and recently they have even worked on the national holidays and on Sundays. I therefore tender to both my foreign and Chinese colleagues my personal gratitude, and desire to tell our guests frankly that the results of the survey, such as they are, have been the work, not of one or two men, but of all the members of the organization.

"For a summary of the history and the functions of the Geological Survey I refer you to the printed pamphlets. I wish only to tender to you once more our sincere thanks, before I respectfully request the President to deliver his address."

Following Dr. Ting's welcoming remarks, H. E. the President of China declared the Geological Survey Library and Museum opened to the public in the following words:

Geology is by no means a new science in China; indeed, it originated here in very ancient times. In the book of Yu, the nature and color of soils were carefully discriminated. In the Chow Dynasty, a mining and geographical staff formed an important branch of the government organization. The book of Kwoitzu touches even on the principles of ore deposition and the manner of locating ore deposits. Since the Dynasty of Han and Wei, trained specialists on copper and silver were constantly employed by the government. Though their knowledge was fragmentary, and their results frequently inconsistent with modern ideas, we can not help thinking that the achievements of those pioneer workers entitles them to be considered as forerunners of the great army of investigators in the modern science of geology. It is only because of the lack of system in the methods of study of the ancient Chinese, that we are at present far behind other countries in this branch of science. As a result of this neglect in the development of this important branch of knowledge, our people remain poor and miserable, because we are not equipped with the necessary knowledge to develop our vast resources, which are at present almost untouched.

As is well known, geology is most intimately related to mining, while mining is the foundation of a nation's prosperity. Important and fundamental though they are, our government has paid no attention to such investigations until very recently.

The Geological Survey of China was organized in 1913, two years after the revolution. Having spared no efforts to overcome the many and serious obstacles in its path, this survey has now reached its present enviable position. This is due entirely to the efficient administration of its officers, and the ambitious labors of all its members. Under almost all kinds of difficult conditions, the members of the survey have willingly and earnestly enlisted to perform their duty—the work of collecting facts and materials, the mapping of many districts, and the study of the various problems connected with the mining industry. Recently the survey has purchased a large number of books in Europe, America and Japan, to serve the needs of its ever growing activities. In 1920 the new museum and library were established, this being made possible by contributions from outside sources. With these facilities, the survey is now able to arrange, in systematic manner, all the minerals, ores, rocks, fossils and books collected from time to time.

To-day is the opening day for the public exhibition of the newly established museum and

library, and I have the great honor to be present on this occasion. I found in the library books on diverse phases of the science of geology and its kindred subjects, well classified and arranged, and in the museum, specimens of almost all the varieties of minerals, rocks and fossils of this country, accompanied by descriptive matter and illustrative maps and sections. It is really a wonderful and marvelous exhibit. I am very sure that both the industrial and the scientific world will be greatly benefitted by the existence of such an organization as this. May I congratulate you, my dear members of the survey, on the success of your work, and the opportunity you have for the future development, in this country, of science and industry—for those are the foundations of our nation's prosperity.

The next speaker was H. E., Chang Kou Kan, the minister of agriculture and commerce, who spoke as follows:

Geological investigation of the country is a technical and scientific subject, as well a necessary branch in the government organization. In order to lay the foundation for industries depending on natural resources, and to point the way for their development, such investigation is absolutely essential. When I myself served as the head of the ministry in former times, I tried hard to promote this kind of investigation. Owing to the lack of funds, however, this organization was not able to expand as it should have. Now the President has taken the lead, followed by many of our mining people, in contributing towards the building of the library, and the expansion of the museum. All signs indicate that the nation as a whole places great hopes in the Geological Survey. It is to be expected that the survey will expand its work, and to complete the geological atlas, and the geological maps of the important mining regions, so that both the industrial and the scientific world will be profited. Thus we shall be able to realize what the president has so earnestly hoped for. Great credit is also to be given to those who have made contributions towards the realization of this aim. Such cooperation between private individuals or companies and the government is perhaps the first of its kind ever practiced in this country.

The next address was delivered by the vice-minister of agriculture and commerce, H. E., Chiang Tien To, who expressed himself as follows:

The main duty of our ministry is to develop our natural resources, thereby making our country a prosperous one. There are many ways that lead to this desired end, but the survey of the geology of the country is one of the most important. In the study of geology we must pay attention not only to field work, but we must also carry on scientific research work. It is for this reason that the geological surveys of other countries are all equipped with modern libraries and museums. The museum of this survey has been established for many years and I have personally visited it several times. I found in it specimens of ores and rocks from all parts of China, furnishing a very good foundation for research. Owing to lack of funds, the survey has not been able previously to build a library. Now the president has taken the lead, together with many gentlemen prominent in the industrial and mining circles of this country, in contributing to this survey the funds which have made possible the erection and equipment of this building. From now on the members of the survey, besides doing field work, will also be able to carry on accurate research work under adequate conditions. I am sure that the results thus obtainable will be profitable to both the industrial and the scientific world. It is hoped, therefore, that the members of the survey will work with renewed enthusiasm, and give of their best, so that the high hopes of the president and the minister may be realized to their fullest extent.

Mr. C. Y. Yen, the industrial commissioner of Chihli, spoke next and expressed his admiration of the work already accomplished by the Geological Survey, not only in building up a very efficient organization but also in contributing actively to the industrial development of Chihli province.

Mr. E. J. Nathan, the representative of the Kailan Mining Administration, the largest donator among the mining companies, expressed his deep satisfaction with the well arranged museum and considerable library which the survey had already been able to bring together. He was convinced that the Geological Survey of China, which had already done so much for the discovery and survey of mineral deposits, will in the future prove a powerful factor in the development of China's mineral industry.

General Yen Chang, formerly minister of war, explained in an eloquent address the importance of the systematic examination and development of the rich treasures which are hidden in the rocky ground of China. The effective organization of the Geological Survey

gives good hope that the public will have excellent scientific help in the promotion of the national mineral industry.

After the opening ceremony the president, followed by the other guests, made a tour of inspection of the library and of the museum.

H. T. CHANG,
Acting Director

PEKING,
JULY 17, 1922

AGGLUTINATION AND TISSUE FORMATION

FOR a considerable number of years the principle underlying our analysis of tissue formation—undertaken with the view of contributing to a physiology of tissues in contradistinction to a physiology of organs[1]—was the suggestion that primarily agglutination is the factor which makes isolated cells join into a tissue, and that this agglutination depends on a certain consistency of the outer layer of the cell protoplasm[2]. In an analysis of tissue formation it was thus necessary to determine the factors on which this consistency depends and we showed that it is a quantitatively variable factor, that this variability is a prerequisite in amœboid movement and that the same agglutinability which determines tissue formation is the cause of what we have called stereotropism of tissue cells, their tendency to move in contact with solid surfaces.[2] Tissue formation, stereotropism and amœboid movement are therefore related phenomena, all depending on a certain variability and regulation in the consistency of the outer layer of the protoplasm. As a step in this investigation we prepared an experimental amœbocyte tissue which consists of motile bloodcells of invertebrates and which readily admits of an experimental analysis of all these associated factors.[3] The basic laws of tissue formation must apply equally to the various kinds of growth, embryonic, regenerative, correlative and tumor growth.[4]

Tissues are primarily aggregates of agglutinated cells. Secondarily certain differentiations may occur which concern the individual cells as well as the connections between these cells. Elementary tissues and even structures resembling particular tissues in certain respects, can be produced from isolated amœbocytes under conditions which we have described in detail elsewhere. Under the influence of environmental changes the consistency of the outer protoplasmic layer of these cells is altered in such a way that it becomes sticky. In this experimental tissue various processes which occur in natural tissues can be imitated. A state of the outer parts of the protoplasm intermediate between liquid and solid is essential for tissue formation, because it insures that degree of adhesiveness necessary for this process. Agglutination is likewise the basic factor, which insures the possibility of the formation of paraplastic structures in which the products of adjoining cells are united into a homogeneous whole.

We showed that the movements of tissue cells take place in contact with surfaces which are solid or approach the solid state, such as fibres. We designated this mode of reaction as stereotropism of tissue cells (1898), and attributed to it a significant part, not only in wound healing, but also in processes taking place normally in the organism whenever movements of tissue cells occur.[5] This stereotropism is apparent not only in normally motile cells, but even in cells which are normally in a fixed condition but which are made to move under conditions which imply a change in environment; it is self-evident that this includes also those environmental changes which take place during embryonal development. We found that this stereotropic reaction can

[1] *Biological Bulletin*, 1903, IV, 1301, Virchow's Archiv. 1903, CLXXIII; 135 Anatomical Record 1912 VI, 109.

[2] Washington University studies 1920, VIII, 3. *American Journ. Physiol.* 1921, LVI, 140. SCIENCE 1921, LIII, 261.

[3] Washington University Studies, 1920. VIII. 3 SCIENCE 1919 L. 502. *American Journal Physiol.* 1922, LX, 277.

[4] Virchow's Archiv. 1903, CLXXIII, 135. *Journ. Med. Research*, 1917, XXXII, 75, 1920, XLI, 247. *Journ. Cancer Research*, 1920, V, 261. SCIENCE, 1922, LV, No. 1410.

[5] Archiv. f. Entwickelungsmech. 1898, VI, 297. 1902, XIII, 487. *Anatomical Record*, 1912, VI, 109. M. S. Fleischer and Leo Loeb. Proc. Soc. Exp. Biol. and Med., 1911, VIII, 133.

be induced and modified experimentally in the amœbocytes and that it depends upon changes in the consistency of the protoplasm, which tend to make it sticky. Stereotropism is therefore an expression of the same factor which leads to the agglutination of isolated cells with each other, which latter results in tissue formation.

The stereotropism of tissue cells depends upon their ability to carry out amœboid movements. On the basis of our observations and experiments we concluded that in amœboid movements, cyclic changes in the consistency of those parts of the protoplasm take place which are concerned in this activity.[6] With these changes there must be associated corresponding changes in the agglutinative power of the tissue cells. The factors underlying amœboid movements are therefore closely related to those determining agglutination and tissue formation; but while in the latter usually the whole surface of the cell is in a viscous state, the cyclic changes in consistency and viscosity of the protoplasm are localized and thus lead to the formation of pseudopods. In modifying this amœboid movement experimentally we have shown that its character varies with the consistency of the protoplasm; only if the latter approaches the liquid state can surface tension play a part in the amœboid movement; but during certain phases of the process the consistency of the protoplasm is so great that the laws of surface tension, as they have been defined for the liquid state of matter, cannot play an essential part in amœboid movement.[7]

Related to amœboid movement but not identical with it, is the spreading out of tissue cells, which occurs under certain conditions, when the cells are in contact with solid surfaces. This process can likewise very conveniently be studied in amœbocytes. Both amœboid movement and spreading out depend upon changes in the consistency of the protoplasm. The spreading out in particular depends upon a softening and relaxation of the outer layer of the protoplasm. Usually this spreading out goes hand in hand with amœboid movement; yet both processes can to a certain extent be separated from each other experimentally. As we have shown, it is possible to increase the consistency of the protoplasm in such a way, that the spreading out is prevented or very much delayed, while amœboid movements are still quite active. Addition of definite amounts of acids to the medium in which the amœbocytes are held, may have this effect. However, in influencing the consistency of the outer layer of the protoplasm as a whole, for instance through the addition of acid, we may also influence the character of the pseudopods in a corresponding manner. Addition of slight amounts of alkali favors very much the extension of the cells by softening the consistency generally.[8] Again the consistency of the outer layer of the spreading out cell is such that adhesiveness results; thus an agglutination of the spreading out cells to the base on which they rest is assured. This spreading out is an important factor in tissue formation and during embryonic development the formation of the mesenchyme depends upon such a transformation of the more or less rounded off blastomeres into cells, which not only assume amœboid movement, but at the same time spread out. We have previously called attention to the importance of changes in agglutinative properties of cells during embryonic development, in which a change takes place from agglutinated round cells, which stick to each other with certain parts of their circumference, to cells spreading out in contact with a solid or viscous substratum.[9]

It can be shown that the stickiness and therefore the agglutinability of cells is a variable factor; but the degree of this variability differs very much in different kinds of cells and under different conditions. We have found that this variability is very great in the case of amœbocytes. In the circulating blood they are not sticky; but as soon as the environment is altered they become sticky, show amœboid movements and agglutinate to each other and to other structures. We have every reason to believe that, while these variations in stickiness are less marked in the majority

[6] *Journal Med. Research*, 1902, VII, 145.
[7] Washington University Studies, 1920, VIII, 3.
[8] *American Journal Physiol.* 1922, LX, 277.
[9] SCIENCE, 1922, LV, No. 1410.

of cells, great variations occur generally. Thus in the resting stage, the endothelial cells lining blood and lymph vessels present a perfectly smooth surface and other cells pass them freely without adhering to them. But when certain changes in the environment occur, these cells may become amœboid and migrate adhering to surfaces; or they assume phagocytic properties, which likewise presuppose certain changes in the surface consistency. It is very probable that similar changes occur in all epithelial or connective tissue cells, when they change from the resting state to the active state of amœboid migration, adhering to surfaces with which they come in contact. Amœboid movement as such implies, as we have shown, a cyclic, localized change in the consistency of the cell and it can be shown that the stickiness of the pseudopod may be greater than that of the rest of the cell. In the majority of the cells the variation in consistency and stickiness is less marked than in the case of the amœbocytes, because they are already naturally in the state of tissue components, adhering with certain parts of their surface to neighboring cells. This applies already to the blastomeres of the dividing egg, in which some parts of the outer layer have such a degree of viscosity that the segmenting cells remain united. The union of cells in resting tissues may be accomplished by means of secondary differentiations, which lead to the production of special structures. There is reason for believing that when, under the influence of certain stimuli these cells enter into the state of amœboid movement, these differentiations are at least partially lost and this implies a change in the condition of the outer layer of the cell, which exhibits amœboid movement and on which the agglutinability, and therefore stereotropism, depends.

Such changes in environment which lead to amœboid movement, alterations in consistency of protoplasm, stereotropic response, play a great part in pathological conditions, in inflammation, wound healing, and tumor growth, in all of which cellular stereotropic movements are a significant factor. Under natural conditions these movements occur not only during embryonic development in various types of cells, but also in the adult organism, for instance in the ovary during atresia of the follicles, in the endothelial cells of the corpus luteum during the formation of blood vessels and in the lymphocytes migrating through epithelial surfaces.

It is possible further to analyse some of the factors and especially the significance of agglutination in the formation of certain tissue structures. In general, cell division not accompanied by amœboid movements tends to the production of epithelial surfaces. Tissues which show active amœboid and spreading out movements, may produce structures which differ according to the relative degree of agglutinability and energy of amœboid movement present. If the amœboid motility is very marked in proportion to the degree of adhesiveness, we tend to have tissues of a more or less loose character. Thus the fibroblasts are connected with each other through relatively small areas of contact, while they are sending out long pseudopodia and moving freely along solid bodies. In epithelial tissues, or in tissues of similar morphological character, the preponderance of amœboid motility over the adhesiveness of the cells is much less pronounced and these cells are therefore joined together in wider surfaces of contact and may form more or less connected layers. The same differences we find between the growth of sarcoma cells, which behave similarly to fibroblasts, and carcinoma cells which are epithelial in character. Great stickiness may lead to the formation of cell clumps, and if it is associated with a tendency to amœboid movement and spreading out of the adhesive cells, it may lead to the formation of tissue layers, in which strands of spread out cells form a net. This net formation is due to the fact that the cells move away from the cell clumps, which serve as centers, and form thus secondarily strands of spread out cells, which connect with each other.

In the process of tissue formation, such as we observe in tissue growing in culture media in vitro, two phenomena are noticeable in outgrowing cells, (1) the stereotropism, which leads the cells to grow in contact with solid surfaces, (2) the tendency of the cells to grow

out in a centrifugal direction away from the piece of tissue implanted; thus a more or less radial and often tree-like branching arrangement of the outgrowing cell strands is produced. We have discussed above the stereotropic response. The centrifugal arrangement can be conveniently studied in amœbocyte tissue. Several years ago we tested experimentally the possible significance of the galvanic current and differences in electric potential in the centrifugal direction of cell migration. Our results were negative, neither did the direction of light rays influence the movements. It is very probable that the centrifugal growth depends upon the following two factors, (1) the tendency of the cells adhering to each other to separate, to send out pseudopodia and to move in such a direction that two or more cells forming a clump become isolated, (2) the tendency of a healthy cell to continue for a certain time to form pseudopods at the same part of the cell at which this process has been induced. These two factors, the existence of which observation of the moving cells verifies, would be sufficient to produce the centrifugal movement, which would thus partly represent a statistical chance phenomenon. Inasmuch as the isolated cells and the cell clumps become less frequent with increasing distance from the central piece, this would insure a centrifugal, more or less net-like growth, or in other cases a tree-like growth, such as we found under various conditions. We may assume that the same factors play a role during the growth within the organism.

Tissue formation depends upon a combination of cell movements and cell divisions. We have seen that contact with a solid base is a prerequisite for the outgrowth of tissues; but in addition we found more recently that in various tissues growing in vitro, a very active mitotic cell division may be induced in favorable liquid culture media supplied with a sufficient amount of oxygen, even under conditions which do not permit an active outgrowth because of the lack of a solid surface along which the cells would be able to migrate.[10]

While it is thus possible to separate experimentally mitotic cell proliferation and migration of cells in tissue cultures, the same stimulus usually tends to produce both of these reactions together. A suitable change in environmental conditions usually brings about alterations in the cells, which lead to both mitotic cell division and migration in tissues, provided they are capable of both of these activities. The difference in actual response on the part of different tissues depends upon the structure of the tissue, which enables certain kinds of cells to migrate very readily and to divide only with difficulty or not at all, and other tissues to divide much more readily than to make amœboid movements.

The stereotropic reaction of tissue cells to an environmental change consists of two component parts, (a) of amœboid movement and (b) of alterations in the consistency of the outer layer of the tissue cells; the latter change may vary very much in different cases. In some cases a previously non-sticky surface may become sticky as the result of the environmental change (as in amœbocytes, the free surface of endothelial cells, perhaps in lymphocytes and certain other cells), while in other cases a certain degree of usually circumscribed adhesiveness pre-existed, but became more general or stronger as the result of the environmental change.

These changes in motility and adhesiveness are responses of a living organism to a stimulus. This is quite apparent in the case of the amœbocytes and in the reactions of the experimental amœbocyte tissue, where a mechanical stimulus leads to that far going alteration in cell consistency, which makes possible both stereotropic reactivity and tissue formation; but in principle, conditions are similar also in the case of other tissues.

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[10] Leo Loeb and Moyer S. Fleisher, *Journ. Med. Research*, 1919, XL, 509.

THE SHENANDOAH CAVERNS

THE exhibition of caverns to the traveling public is noted by the United States Geological Survey as a growing industry in the Shenandoah Valley of Virginia. The famous Valley Pike, now a link in the New York to Atlanta highway, is traversed yearly by thousands of automobile tourists, and no one has adequately

seen America who has not visited one or more of the caverns in the Shenandoah Valley. Until recently the only caverns that were accessible to the public were the celebrated Luray Caverns, in Page County, and Weyer's Caves, in northern Augusta County, near Grottoes. However, within twelve months, the Endless Caverns, near New Market, in Shenandoah County, have been opened, and on May 31 another cavern near Mount Jackson, also in Shenandoah County, made its first bid for public favor.

The latest-opened caves have been named Shenandoah Caverns. They are about three miles south of Mount Jackson and two miles west of the Valley Pike, with which they are connected by a macadamized road. The visitor descends into these caverns by a concrete stairway and soon sees the first stalactites, which appear as stout daggers of crystallized lime carbonate, hanging like icicles from points where surface water drips from the limestone roof. At the foot of the stairs is the spacious anteroom to a long chain of high-vaulted chambers connected by narrow passageways, forming in general plan a gigantic letter S, all illuminated by cleverly concealed lights. Attractive natural decorations are found in every room. Here the side walls are covered by fluted veneer done in crystal stucco, there in graceful drapery hang creamy lambrequins in ruddy-tinted stripes. From place to place, singly or in groups, are pendent stalactites and uprising stalagmites—the first inverted narrow cones fed by trickling films of lime-bearing water; the second pillars or columns fed by spattering drops of the water. In one room midway down the chain the show piece is a narrow 30-foot cascade of white glittering crystal flanked by twin falls of pale translucent ocher. At the base and to the rear of this diamond cascade, visible by peering between slender columns of oriental alabaster, is the "Fairy's Secret," a tiny pool illuminated in due season by animated torches, presumably carried by a brood of phosphorescent larvæ of some insect, perhaps a small fly that is commonly present in such caverns. At the end of the developed portion of the cavern a chamber of high vaulted roof suddenly gives place to a low-ceiled room containing a lakelet in which are mirrored a multitude of delicate stalactites—a pool of a thousand crystal pendants.

According to A. C. Spencer, of the United States Geological Survey, the caverns of the Shenandoah Valley are far more numerous than the casual visitor would be likely to imagine. The rocks in which the broad trench-like valley has been excavated by water are mainly limestone, and wherever these rocks occur the existence of caverns is indicated by two unfailing signs—the presence of innumerable water sinks and the absence of brooks tributary to the rather regularly spaced creeks. The brookless tracts receive a due share of rainfall and must obviously contribute water to maintain the flow of the creeks and rivers, but their contributions are not delivered by way of the surface drains, but through underground channels that supply copious springs in the deep valleys. The sinks are rude funnels, by means of which surface waters are diverted to the subterranean waterways.

The development of extensive underground waterways in limestone formations like those of the Shenandoah Valley hinges upon the two geologic facts that large masses of rock are always cut by joints and that limestone is dissolved by rainwater, which always contains more or less carbon dioxide. Surface water entering fissures, joint cracks and bedding planes attacks the limestone walls and thus by a process of etching converts close fractures and joints into relatively open crevices. As this process of solution goes on lateral connections will be made from crevice to crevice, and the downward etching of the linked openings will be halted only when the subsurface water channels have become closely adjusted to the water table controlled by surface streams. Thus it is that the caverns of the Shenandoah Valley are formed.

THE SALT LAKE CITY MEETING

THE sixth annual meeting of the Pacific Division, American Association for the Advancement of Science, held at Salt Lake City, June 22 to 24, 1922, in conjunction with a summer session of the national association, was

perhaps the most successful meeting since the organization of the division and, in the opinion of those who attended at least, thoroughly justified the policy of the Executive Committee, maintained in the face of some opposition, to hold the annual meetings in rotation in widely separated centers of population throughout the Pacific Coast region.

While Salt Lake City is somewhat isolated geographically with respect to the major portion of the membership of the division, and its inaccessibility prevented the attendance of many who would have attended a meeting in a coastal city, nevertheless the number in attendance exceeded the expectations of the committee and comprehended a very good representation of the active scientists of the Pacific Coast. Besides, owing to the cooperation of the National Association which called a summer session at the same time and place, many distinguished men attended from the middle west and eastern points.

The general sessions and the meetings of the affiliated societies were accommodated at the University of Utah, which is beautifully located in the eastern part of Salt Lake City on a plateau commanding a view of the great valley which is geologically famous as Ancient Lake Bonneville.

Eleven affiliated societies united with the Pacific Division in holding meetings upon this occasion as follows:

The American Physical Society.
American Meteorological Society.
American Phythopathological Society, Pacific Division.
Ecological Society of America.
Pacific Coast Entomological Society.
Pacific Slope Branch, American Association of Economic Entomologists.
Pacific Division, Physiological Section, Botanical Society of America.
Seismological Society of America.
The Society of American Foresters.
Utah Academy of Sciences.
Western Society of Naturalists.

Sessions of extraordinary interest were reported in each case and many significant papers were presented which it is hoped will find publication in the various technical journals if not in the organs of the association.

In addition to the regular meetings of the affiliated societies there was a meeting of the agronomists and soil experts which resolved itself into an "Alkali Congress" in which the experience in reclaiming alkali soils in various sections of the west was presented with great mutual benefit. It was determined to organize a permanent association which would affiliate with the Pacific Division and hold regular meetings in future.

The general sessions of the Pacific Division were well attended and of more than usual interest. Dr. John A. Widtsoe addressed the Research Conference, speaking on "The research problems of the Great Basin."

The address of the retiring president, Dr. Barton Warren Evermann, on "The conservation and proper utilization of our natural resources," provoked a warm eulogium from President George Thomas, of the University of Utah, and from Dr. L. O. Howard. A pleasant feature of this session, which came as a surprise to the recipients no less than to the audience, was the conferring of the degree of doctor of laws upon Dr. Barton Warren Evermann, president of the Pacific Division and director of the Museum of the California Academy of Sciences, and Dr. James Harvey Robinson, associate of the New School for Social Research of New York City. With impressive ceremony the degrees were conferred by President George Thomas, of the University of Utah, who stated that the honor had been conferred but six times previously in the history of the university.

Of peculiar interest and significance at this time was the session devoted to the symposium on "The Problems of the Colorado River." The great reclamation project, which contemplates the utilization of the waters of the Colorado River for power and irrigation, involves the more or less conflicting rights of seven states. The thorough discussion of the scientific phases of this subject was of absorbing interest, and will prove to be a direct contribution to the furthering of the project. The papers presented in this symposium will doubtless be published in SCIENCE.

A notable feature of the convention was the address by Dr. James Harvey Robinson, which appeared in a recent number of SCIENCE.

Announcement was made of the election of Dr. E. C. Franklin, professor of chemistry, Stanford University, as president of the Pacific Division for the ensuing year.

A resolution was unanimously adopted expressing appreciation and gratitude to the University of Utah, the Brigham Young University, the Utah Academy of Sciences and the Utah Agricultural College, who acted as hosts to the convention. The great success of the meeting was largely due to their very efficient handling of the arrangements.

Dr. Robert G. Aitken, astronomer of Lick Observatory, was elected a member of the Executive Committee in place of Dr. W. W. Campbell, whose term expired.

The thoughtful hospitality which marked the reception and entertainment of visiting members reached its climax on the last day of the convention, when automobiles and lunches were provided and the visitors who had previously designated their choice of several all-day excursions were conveyed under the guidance of scientific experts to points of interest in this famous region of geological records and scenic wonders.

An organ recital in the Mormon Tabernacle and a dip in Great Salt Lake in the cool of the evening brought the final day of the convention to a close.

There was a total registration of about 400, of which 110 were members of the association.

The publicity afforded through the local press of Salt Lake City was very gratifying. Each year there is apparent a wider general interest in the proceedings of the annual meeting which promises well for its future usefulness.

W. W. SARGEANT

SCIENTIFIC EVENTS

THE INTERNATIONAL RESEARCH COUNCIL

IN an article in *Nature* it is stated that a meeting of the International Research Council was held at Brussels on July 25 and the four succeeding days, under the presidency of M. E. Picard, secretary of the Académie des Sciences, Paris. Twenty countries have now joined the International Research Council, the following seventeen being represented at the meeting: Belgium, Canada, Denmark, France, Great Britain, Greece, Holland, Italy, Japan, Norway, Poland, Portugal, Spain, Sweden, Switzerland, United States of America, and Czecho-Slovakia.

The greater part of the business of the meeting was concerned with the organization of international scientific unions additional to the five for Astronomy, Geodesy and Geophysics, Chemistry, Mathematics, and Scientific Radio-Telegraphy, which are already in activity. As a result of the meeting the formation of unions for Pure and Applied Physics and for Geography is said to be assured. The proposed union in Geology awaits the consideration of the Geological Congress, and some advance has been made in connection with the biological sciences.

At a previous meeting of the International Research Council it had been provisionally agreed to unite medical and biological sciences; this decision did not find favor, and the intention now is to separate medicine from physiology, zoology and botany. Proposals will be submitted to the countries belonging to the Research Council, and the ultimate formation of this union will depend on the number of countries willing to join.

Among other matters dealt with, a proposal submitted by the National Research Council of the United States and accepted by the meeting may prove to be an important addition to the responsibilities of the Research Council, which hitherto contented itself with the formation of unions which became practically autonomous as soon as their statutes were approved. As problems in which several unions were concerned ran a danger of being neglected, the proposal was now made by the United States that the Research Council itself should take such problems under its own special protection. Three inquiries were mentioned as likely to fall within this category. One of them had already been considered by the International Astronomical Union, which requested the Research Council to make arrangements for a collaboration of several of the unions in the study of the correlations between solar and terrestrial phenomena. The second referred to the

energy supply of the world (fuel, solar energy, etc.), while a third suggestion dealt with the difficult and complicated question of international patents. The risk of overlapping efforts and the possible fear of interference with the special work of the unions is avoided by the provision—now coming into force—that the executive committee of the Research Council, which hitherto consisted of five members, should be enlarged, each union nominating an additional member.

At the concluding meeting the five members of the executive committee appointed by the general assembly were elected as follows: M. E. Picard (president), Mr. G. Lecointe and Professor Vito Volterra (vice-presidents), Dr. G. E. Hale, and Sir Arthur Schuster (general secretary).

THE ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS

THE sixteenth annual convention will meet September 11 to 15 at Cleveland, Ohio, at which time there will be presented and discussed subjects dealing particularly with steel mill problems.

The papers have been written with a view of giving to the engineers as much practical data as is possible, feeling that this class of information is far more beneficial than the theoretical side when dealing with steel mill problems.

Some of those who will present and discuss the subjects are Dr. C. P. Steinmetz, Messrs. B. G. Lamme, Wilfred Sykes, A. G. Witting, F. C. Watson, D. M. Petty, L. W. Heller, R. B. Gerhardt, D. B. Rushmore, J. B. Crane, E. R. Fish, H. M. Rush, R. M. Butler, F. Hodson, Professor Edgar Kidwell, F. W. Cramer, A. R. Leavitt, E. T. Moore, R. H. Bauer, F. A. Wiley, L. F. Galbraith and R. S. Shoemaker.

A tentative list of the subjects to be presented are:

Improvement in Efficiency of Electric Power Supply.

A Review of Steel Mill Electrification.

Boiler Practices of 1922.

Education and Safety.

The Gas Engine as a Prime Mover for Power Generation.

Steam Turbines.

Judging Combustion from Gas Analysis.

Electrification of the International Nickel Company's Works for Monel Metal.

Some Considerations in the Electrification of the Steel Plant Railroad Yard.

Power in the Iron and Steel Industry.

Control—Motor—Lighting and Crane Standardization.

Electric Furnaces.

Electrical Developments in 1922.

Investigation of Insulators for Steel Mill Service.

In addition to the technical sessions, there will be an exhibition of apparatus of particular interest to the steel mill engineers. This exhibit will cover approximately 30,000 square feet of floor space and will be held in the same hall as is the technical sessions.

Representatives from practically every steel mill in the United States are expected at this convention for it is planned to interest practically every class of engineer, such as general managers, general superintendents, department superintendents, chief engineers, steam engineers, electrical engineers, electrical superintendents, mechanical engineers, master mechanics, superintendents of power, engineers of tests, safety engineers and department foremen.

THE AMERICAN ELECTROCHEMICAL SOCIETY

THE meeting will be opened by President Schluelerberg at Montreal on Thursday, September 21, and the technical program will proceed with the presentation and discussion of papers on electrolysis and electroplating. The recently organized Division on Electrodeposition (G. B. Hogaboom, *chairman;* Wm. Blum, *secretary*) will be well represented and take active part in the discussion of these papers.

One of the papers of the Thursday morning session will deal with the physical properties of electrolytic iron—a product which is being turned out commercially, contrary to all predictions of ten years ago. There will also be papers on zinc, brass and other electrodeposited metals.

On Thursday afternoon and Friday morning a symposium on "Industrial Heating" will be in progress. The Electrothermic Division

(Bradley Stoughton, *chairman;* Colin G. Fink, *secretary*), which held a most successful symposium on "Electric Cast Iron" at the Baltimore meeting, in April last, will again be in charge. Twelve papers especially prepared for this session and dwelling on industrial heating in electric furnaces, other than fusion and melting furnaces, will be placed open to discussion.

There will be papers on:

a. History of industrial heating.

b. Principles of design of furnaces.

c. Comparison of fuel costs in different types of electric furnaces, and with combustion furnaces. (In this connection, electric energy would be estimated as a "fuel cost.")

d. Resistor materials.

e. Specific heats.

f. Electric conductivity of insulating materials at industrial furnace temperatures.

g. Heat emissivity.

h. Heat transfer.

There will be an excursion to Shawinigan Falls, affording members an opportunity to inspect the various industrial plants of one of the most progressive centers on the continent. It is planned to have a special train for this all day trip from Montreal.

A popular lecture on "Progress in physical science" is scheduled for Thursday evening. Section Q will be in charge of an old-fashioned smoker on Friday evening.

The headquarters for this meeting will be the Hotel Windsor. Members and guests are urged to make their hotel reservations immediately.

THE BIOLOGY CLUB OF THE OHIO STATE UNIVERSITY

DURING the academic year of 1921-1922, the Biology Club of the Ohio State University held monthly meetings from October to May inclusive. Considerable interest was manifested in the programs, to which contributed various members of the biological and related departments, and some graduate students doing original research in these departments. The following papers were presented:

October 3: "Experiences in England, with observations on the status of botanical research and interest there," Professor A. E. Waller.

November 7: "The ductless glands," Professor R. G. Hoskins; "The work of the Ohio State Fish Survey," Professor R. C. Osburn.

December 5: "Glaciation of the San Juan Mountains, with notes of paleontological and natural history interest," Dr. R. F. Webb.

January 9: Reports of the zoological and entomological meetings and other sessions and general meetings of the American Association for the Advancement of Science, at Toronto, Professor R. C. Osburn, Professor F. H. Krecker, Professor D. M. DeLong, Professor C. H. Kennedy.

February 13: "The problems of biology from the standpoint of a philosopher," Professor A. E. Avey.

March 6: "The distribution of the dragon flies of the Put-in-Bay region," Professor C. H. Kennedy; "The reactions of house flies to radiant heat," Professor W. M. Barrows.

April 3: "The physiology of the guard cells of *Rumex patientia,*" Mr. J. D. Sayre; "The nature of twig abscission in cottonwood, *Populus deltoides,*" Miss Lois Lampe.

May 8: "Mushrooms and toadstools," Professor W. G. Stover; "Habits of aphid parasites," Mr. H. Spencer.

The president of the club for the year was Dr. E. P. Durrant, of the department of physiology; the vice-president, Dr. R. C. Baker, of the department of anatomy, and the secretary-treasurer, Mr. W. C. Kraatz, of the department of zoology and entomology.

THE GORGAS MEMORIAL

IN response to a request received from the directors of the Gorgas Memorial Institute of Tropical and Preventive Medicine for the cooperation of the American Medical Association, a committee representing the association was appointed consisting of Dr. Charles W. Richardson, Washington, D. C.; Dr. Fred B. Lund, Boston, and Dr. George E. de Schweinitz, Philadelphia. This committee has presented the following report:

As a result of the stimulating suggestion of President Porras, of Panama, it has been resolved that a fitting memorial shall mark the humanitarian service of the late Major General William C. Gorgas, and the beneficent influence of his life and work on mankind throughout the world. Following the thought of President Porras, it has further been decided that this memorial shall take the form of a scientific institute for the study

of tropical diseases and of preventive medicine.

No better place could have been selected than Panama City, the gateway between the Atlantic and the Pacific, where General Gorgas' well-planned and executed work made possible the building of the Panama Canal.

It is hardly necessary to call the attention of the medical profession to the far-reaching effects of General Gorgas' work on the welfare of the people of the whole world, especially in tropical and semitropical climates, and in all places subject to the inroads of infectious disease.

We of the medical profession remember him as our surgeon general during the early part of the World War. We remember his prompt recognition of the necessity of bringing into active service large numbers of physicians and surgeons from civilian life. We remember his genial and kindly nature, his high character, and his steadfast effort directed toward the organization and equipment of the medical corps of the Army. We remember the patriotic response. We remember him as a great sanitary officer, to whom we wish to pay a lasting tribute.

A central committee has been formed, with Admiral Braisted, retired, ex-president of the American Medical Association, as its president. The American Medical Association has appointed a committee of three to work in accord with the central committee, and through its members this appeal is made to the American medical profession.

The plan is to build at Panama an institute for the study of tropical and infections diseases, with a hospital, laboratories, departments for research and all other facilities required in an institute of this character, erected and administered according to the most progressive, modern ideals. The Panamanian government, owing to the far-sighted, philanthropic vision of President Porras, has donated the great Santo Tomas Hospital, and also the ground on which it is proposed immediately to construct the buildings as they have been described. Dr. Strong has been appointed the scientific director.

In conjunction with this work in Panama, there will be established in Tuscaloosa, Ala., the Gorgas School of Sanitation for the purpose of training country health workers, sanitary engineers and public health nurses, especially educated to deal with the problems peculiar to the southern states.

An endowment of six and one half million dollars will be required to enable the institute to carry on the work according to the plans which have been formed.

The Republic of Panama has demonstrated its sympathetic and practical interest in this enterprise with splendid liberality. The physicians of our country, and especially the members of the American Medical Association, surely will not disregard the memory of a former president, and will seize the opportunity to make in this respect a contribution of which they will be proud.

The campaign for funds is to be international. A large response is expected from North, Central and South America, since the nations of these countries have been the chief beneficiaries of the labors of General Gorgas. It is fitting that his co-workers of the American medical profession should be requested to respond generously to this appeal. It is hoped that every member of the American Medical Association will make as liberal a subscription as possible. Any sum will be gratefully received. Checks should be drawn to the order of the "Gorgas Fund" and should be mailed to the American Medical Association, 535 North Dearborn Street, Chicago.

SCIENTIFIC NOTES AND NEWS

DR. E. T. WHITTAKER, professor of mathematics in the University of Edinburgh, has been elected a foreign member of the Accademia dei Lincei, Rome.

PROFESSOR W. ROUX, of Halle, has been elected honorary member of the Academy of Medicine at Turin. Professor Roux has presented to the Roux Foundation for research on the mechanics of development the 30,000 marks recently sent him by the St. Louis Emergency Relief Committee for German and Austrian Universities.

PROFESSOR A. N. WHITEHEAD, of Cambridge, has been elected president of the Aristotelian Society for the coming session. He will deliver his inaugural address on November 6.

DR. N. BISHOP HARMAN, of London, has been elected a corresponding member of the Cherbourg Scientific Society, in recognition of his researches into the origin of the facial musculature.

WILLIAM SCHAUS, of the Bureau of Entomology, has been elected an honorary member of the Entomological Society of Brazil in recognition of his extensive work on the butterflies and moths of Brazil.

POSTMASTER GENERAL HUBERT WORK, for-

merly president of the American Medical Association, was the guest of honor at a dinner on July 26, in Washington, given by the chargé d'affaires of the Panama legation, Señor Lefevre, in honor of the committee of the American Medical Association appointed to cooperate with the board of directors of the Gorgas Memorial.

MR. W. H. DINES has retired from the directorship of the Aerological Observatory of the British Meteorological Office at Benson.

DR. F. VON LUSCHAN, professor of anthropology at the University of Berlin, retires this year, having reached the age limit.

G. R. MANSFIELD has been appointed chief of the section of non-metalliferous deposits in the Geologic Branch of the U. S. Geological Survey.

DR. J. S. FLETT, director of the British Geological Survey, will act as one of the delegates of the Geological Society of London at the International Geological Congress at Brussels on August 21 to September 3. The other delegates nominated by this society are Professor E. J. Garwood, vice-president, and Dr. J. W. Evans, F.R.S.

THE Röntgen Society, London, has elected as president Sir Humphry Rolleston, and as vice-presidents Sir W. H. Bragg, Sir Ernest Rutherford and Dr. A. E. Barclay.

PROFESSOR THOMAS F. HOLGATE, of Northwestern University, has returned home after a year's leave of absence in China, during which time, though nominally on a vacation, he assisted in the mathematical and administrative work of the University of Nanking.

ATHERTON SEIDELL, of the Hygienic Laboratory, U. S. Public Health Service, is in Europe to study methods and progress of work on vitamines.

DR. F. W. PENNELL, curator of botany in the Academy of Natural Sciences, Philadelphia, accompanied by Mrs. Pennell and by Mr. E. P. Killip, of the National Museum, have gone to Colombia, where about six months will be spent in botanical exploration in the central and western Cordillera.

IT is announced in *Nature* that Dr. Michael Grabham has gone to Porto Santo, the northern island of the Madeira group, to study the conditions under which the local race of Portuguese inhabitants are said to enjoy complete immunity from dental caries. These people possess huge, ugly, yellow, but sound teeth, and Dr. Grabham proposes to bring specimens to London.

A. E. FATH has taken furlough from the Geological Survey to do private geological work abroad.

WE learn from the *Journal* of the Washington Academy of Sciences that at the call of Secretary Walcott, a meeting of the scientific staff of the Smithsonian Institution and its branches was held on May 23 to discuss the promotion of research. Several research problems which could be advantageously taken up were suggested, together with means for carrying them out. A committee on research was then appointed by the secretary, consisting of Dr. Merrill, *chairman*, Dr. Coville, Dr. Fewkes, Mr. Fowle, Dr. Hough, Mr. Nelson and Dr. Stejneger. The committee will hear reports by individuals on proposed research projects and consider means for taking them up, and it is hoped that by fall a definite plan of action will be formulated.

PARK BENJAMIN, the well-known patent lawyer, formerly editor of *The Scientific American* and of Appleton's "Cyclopædia of Applied Mechanics," died on August 21, in his seventy-fourth year.

DR. ARTHUR RANSOME, F.R.S., known for his contributions to the study of tuberculosis and public health, died on July 25 at the age of ninety-two years.

A COMMITTE has been organized, as has already been reported in SCIENCE, to collect subscriptions for the monument to the memory of Professor Yves Delage which it is proposed to erect near the marine laboratory at Roscoff, Finisterre. Several Americans have worked at this laboratory and all biologists are indebted to Delage not only for his discoveries in marine biology but also for his organization of zoological science, his book on protoplasm and heredity and "L'Année Biologique." Sub-

scriptions to the memorial may be sent direct to Mlle. L. Dehorne, treasurer of the committee, at the Laboratory of Zoology, Sorbonne, 1, rue Victor-Cousin, Paris, 5e, or through any one of the American members of the committee, F. R. Lillie, T. H. Morgan and C. B. Davenport.

WE learn from the *Journal* of the American Medical Association that Professor E. Marchiafava, having reached the age of seventy-five, retired, June 5, from the chair of pathological anatomy at the University of Rome after forty-eight years of continuous incumbency. A fund has been endowed in his name by contributions from royalty, the city of Rome, the Italian Red Cross, the public health service, the hospitals and banks, and others, to found scholarships at the University of Rome. A number of addresses were made by delegates from various scientific societies and Marchiafava's numerous contributions to science were enumerated, his initial research on malaria and his leadership in the campaign against malaria in Italy, his discovery of the estivo-autumnal parasite, of the cause of melanemia, and his studies in syphilis, tuberculosis, alcoholism, etc. The city of Rome has always regarded him as the one responsible for having freed it from malaria. One of his latest works was the foundation of the Asilo Antimalarico Communale as a home in Rome for the children of families living in the malaria infested marshy districts in the region. A tablet was placed on this building by the community when it was inaugurated last year, paying tribute to Marchiafava as the originator of the project.

THE tariff bill as passed by the Senate provides for the continuation of the policy that scientific instruments and apparatus which are imported by educational institutions and used solely for educational purposes shall be admitted free of tariff duty. The provision was adopted by a vote of 30 to 26.

THE *Journal* of the American Medical Association notes that in the final passage of the tariff bill, the Senate reversed its position on the importation of dyes and synthetic medicines, and placed extremely high duties on all such articles. There was read to the Senate a letter from Secretary of War John W. Weeks urging that the American dye industry and synthetic medicine industry be protected in the interest of national defense and public health. While the Senate did not vote that there should be an embargo on these products, the tariff duties are of such nature that they will in effect be a conservative check on the importation of dyes and synthetic medicines derived therefrom. The new duties fix the duty on coal-tar dye intermediates at 10.5 cents a pound and an additional 75 per cent. ad valorem, and on finished dyes and coal-tar products, 90 per cent. ad valorem. In urging the adoption by the Senate of these rates, Senator Wadsworth, of New York, showed that England, France and Italy have placed an embargo against the importation of dyestuffs. He said that as a people we have paid little attention and given small encouragement to scientific research. He asserted that chemical laboratories can not be maintained unless there is a chemical industry, and that research in the laboratory and chemical industry go hand in hand. As a result of the action taken by the Senate on this legislation, it is said that approximately 200 laboratories and plants manufacturing medicinals and coal-tar products which have been built up in this country since the war will be enabled to continue operations.

THE American Dietetic Association will hold its fifth annual meeting in Washington, D. C., October 16 to 18, with headquarters at the New Willard Hotel. Speakers of national reputation will discuss recent developments in dietetics, as well as administrative and other practical problems of the dietitian. Trips to Walter Reed Hospital and the scientific laboratories of the government will give opportunities to observe the research work now carried on in Washington. An exhibit of equipment, food materials, charts and other illustrative matter will be a feature of the convention.

UNDER the auspices of the New England Section of the American Society of Agronomy, and in cooperation with the Maine Agricultural Experiment Station and Aroostook County Farm Bureau, some thirty agronomists, pathologists and others interested in problems

of potato production spent three days from August 8 to 10 in Aroostook County, Maine, inspecting potato fields and discussing problems of certification and production. A formal program was rendered.

STEPS were taken recently by the Boston Chamber of Commerce to organize a New England Research Council to study the food supply and marketing problems of the region. President K. L. Butterfield, of the Massachusetts College, was elected chairman of the groups of agricultural colleges and the federal and state departments of agriculture and other agencies interested in the formation of the council.

WE learn from the *Journal* of the American Medical Association that members of the British Medical Association have been asked to contribute five shillings each in answer to the appeal for help from Russian medical men and their families. Up to July 3 $3,500 had been received.

UNIVERSITY AND EDUCATIONAL NOTES

THE will of the late William Sloane makes bequests to public institutions amounting to about $600,000, including Yale University, $100,000; the Presbyterian Hospital, $100,000; New York Public Library, $50,000; Metropolitan Museum of Art, $50,000; American Museum of Natural History, $50,000; Robert College of Constantinople, $10,000, and Yale Foreign Missionary Society for the institution known as "Yale in China" at Changshau, $10,000.

BY the will of the late Rollin D. Salisbury, of the University of Chicago, his estate, amounting to $125,000, is left in trust to his two sisters, on whose death one third goes to the University of Chicago for the endowment of scientific fellowships and $2,500 to Beloit College. Two former associates of Dr. Salisbury in geological research, Dr. Wallace W. Atwood, now president of Clark University, and Dr. Harlan H. Barrows, head of the University of Chicago department of geography, will share in the division of Dr. Salisbury's library.

DR. J. SCHNEIDER, of Milwaukee, has been elected "honorary senator" by the University of Würzburg in recognition of his donation of 3,000,000 marks to the university on the recent anniversary of its foundation, 340 years ago.

DR. R. FITZ, professor of medicine in the Mayo Foundation and chief of a medical section, has become associate professor of medicine at Harvard University and visiting physician at the Peter Bent Brigham Hospital, Boston.

DR. WILLIAM C. ROSE, professor of biological chemistry at the medical school of the University of Texas, has been appointed associate professor of physiological chemistry at the University of Illinois.

DR. WILBUR C. SMITH, since 1916 professor of anatomy in Tulane University, has been appointed director of athletics.

DR. CHARLES B. MCGLUMPHY has been appointed assistant professor of pathology at Northwestern University Medical School. He has been working in Vienna for the past two years.

MR. R. M. WILSON, at present principal of the East Anglian Institute of Agriculture, Chelmsford, has been appointed principal of the South-Eastern Agricultural College, Wye.

DR. J. S. DUNN has been appointed to the Procter chair of pathology and pathological anatomy at Manchester in succession to Professor H. R. Dean.

DISCUSSION AND CORRESPONDENCE

METEORITE HUNTING

TO THE EDITOR OF SCIENCE: The experience of the writer in "meteor chasing" fully corroborates those of Dr. Merrill as related in SCIENCE for June 23. The general inability of the observers to furnish reliable data of the event can scarcely be exaggerated. Despite this, however, the writer has in two instances succeeded in "running to earth" the meteorite and securing a large portion if not all of it.

He also has to announce the recent obtaining of two pieces of meteoric iron (siderites) which were plowed up by a farmer in making

a tobacco bed three miles southwest of Glasgow, Barren County, Kentucky. They exhibit on fresh surfaces, even without etching, very coarse Widmanstadt structure. One of them weighs about twenty-five and the other about twenty pounds. They are both very much oxidized on the surface, and had evidently been in the earth a very long time. The smaller piece goes to the National Museum, where doubtless it will be described in full by Dr. Merrill in the near future. We propose for this fall the name "Glasgow siderite." It is the fifteenth meteorite known from Kentucky.

In hunting down the first meteorite the writer secured after he came to Kentucky—the Bath Furnace, which fell November 15, 1902, at 6:45 p.m. central time—he had good success in obtaining from a large number of observations *five* which were so accurately expressed as to angular measurements that they indicated southern Bath County, Kentucky, as the place of the fall. It was here that the first two pieces of the meteorite (an aerolite) were almost immediately recovered, and this was followed five months later by the discovery by a squirrel hunter of the main portion.

It is in the attempt to locate a meteorite which passed over Indiana, Kentucky and West Virginia, early in the evening of May 30 last, 7:30 central time, 8:30 eastern time, that the writer has thus far been baffled by the singular ineptitude of the average man, and even of the man supposed to be above the average in intelligence, to grasp the space relations involved in the problem of a body coming to the earth from without. To his request through the newspapers for observations on this meteor the writer has received prompt replies from a large number of persons. They came from four states—Ohio, Indiana, Kentucky and West Virginia—manifest the greatest eagerness to serve the cause of science, and represent, for the most part, the more intelligent of the various communities from which they come; yet even by a follow-up correspondence it has thus far been almost impossible to obtain from any of them reliable data concerning the main thing desired—namely, the compass direction of the point of disappearance of the meteorite, either by "bursting" or sinking below the horizon, as seen from the place of observation. Another thing desired was information concerning any sounds, as of cannonading, that might have been heard in connection with the "bursting," and if such were heard, what was the interval between the two phenomena.

It is evident from the replies received, that while people about us *formally* subscribe to the doctrine of a spherical earth, surrounded by infinite space, *practically* their conception of the universe when it comes to orienting themselves in it with reference to things terrestrial and things celestial is as primitive as that delineated on the monuments of Egypt, set forth in the writings of the ancient Chaldeans and Hebrews, or promulgated from the pulpit of Voliva of Zion City.

Knowing that few people possess compasses, and that still fewer know how to use them in measuring degrees of azimuth, the writer sent out maps, with the direction to each observer that he return it after he had oriented it with reference to the points of the compass and drawn a line on it from the place of observation toward the point of bursting or disappearance of the meteor. It has been surprising (though we should have been prepared for it by previous experience) to find how few people can locate points correctly on a map, or indeed use a map for any of the purposes for which it has been made. One of the parties, and he a college professor, evidently held the map above his head in an effort to make it represent the sky and tried to show by a curved line on this flat surface, and hence in a different plane, what appeared to him to be the descending path of the meteor. As other evidences of the survival of naïve primitive conceptions as to the relation existing between the "heavens and the earth," all the Indiana observers were sure the meteorite fell in their state, with commendable state pride making the "circle of the heavens" meet that of the earth on their side of the Ohio River. The pot of gold is to be found at the end of the rainbow just over the neighboring hill. Hence also the Ohio observer, who saw it from a moving automobile, was sure that he could conduct the writer to the exact spot where the

meteorite fell, which he described as in a ravine four and one half miles southeast of Oxford, Ohio. Hence, also, the size of it was variously estimated as "six inches in diameter," "as large as a dinner plate," "as large as a lard can," "as large as a barrel"; and the path of it on the face of the firmament was described as "descending toward the earth" (really it was passing toward the horizon) "with a moderately descending course," "at an angle of 45 degrees," "at an angle of 65 degrees"—all blissfully unconscious that these estimates mean nothing to any one but the one making it. A doctor described the bright trail left by the meteor as "20 feet long." Two of the observers at different points, neither of them closer to it than 50 miles, despite the fact that sound waves travel with a very low velocity as compared to those of light, were certain that they heard a "swishing" or "hissing" noise accompanying the meteor as it sped across the sky. A number attempted to give the direction of the *path* of the meteor with reference to the points of the compass, not realizing that this was impossible in all cases where it did not pass through the zenith of the observer, because only one of the components of its course—that athwart the line of his vision—could be determined by him.

Let us hope that when our present boy scouts come to maturity, having been trained in a proper knowledge of their relation to their physical environment, which has been so sadly neglected in our schools—is it because the teaching of the boy has been so exclusively delegated to women?—those who then follow "meteor chasing" as a scientific recreation may find their efforts to elicit information concerning things celestial, when they come into relation to things terrestrial, crowned with better success than were those of their predecessors.

Meanwhile the meteorite of May 30, 1922, lies hidden somewhere in the most mountainous portion of West Virginia, probably, according to the advices received from Dr. I. C. White, state geologist of that state, within the area covered by the counties of Fayette, Greenbrier, Raleigh and Summers. What an exasperating way meteorites seem to have of so frequently selecting the wildest and most rugged portions of our earth in which to bury themselves![1]

ARTHUR M. MILLER
THE UNIVERSITY OF KENTUCKY

THE FOURTH RECORD OF THE OCCURRENCE IN THE ATLANTIC OCEAN OF THE WHALE SHARK, RHINEODON TYPUS

ON the early morning of May 19, 1922, while the Munson liner, *American Legion*, Charles H. Zearfoss master, was crossing over the banks which lie northeast of the Abrolhos Light, off the coast of Brazil, in Lat. 17° 57′ S. and Long. 38° 41′ W., a large shark was struck by the stem of the vessel and held doubled around the bow for some hours. It was photographed and an attempt was made to get it aboard, but the weight was too great.

It was struck just behind the gills and, with about eight feet of the head end on one side of the bow and some twenty-two feet of the body and tail on the other, it was so perfectly balanced that the vessel had to be stopped and backed before it could be got rid of.

Photographs sent me by Mr. C. F. Krauss, a passenger on the steamer, and by Captain Zearfoss, show only a part of the body, but they show plainly the spots arranged in vertical rows and separated by vertical bars, the distinctive markings of the whale shark. These photographs leave not the faintest shadow of doubt that the shark was *Rhineodon*.

This then definitely constitutes a fourth record for the Atlantic Ocean of the occurrence of the largest of all the sharks, and of the rarest of all the large sharks. The other

[1] Since writing the above, letters from two persons in West Virginia—W. T. Hill, Eskdale, Kanawha County, and M. W. Venable, who saw the meteor from near the mouth of Glade Creek, Raleigh County—indicate that the meteorite is probably to be looked for in Greenbrier County, that state. The former heard a "rumbling sound" in a due east direction about one minute after the meteor disappeared, and the latter a "tremendous roar similar to a salvo of artillery" simultaneous with the bursting of the meteorite with a "brilliance almost blinding" in a direction a little east of north.

records are as follows: In January, 1902, an 18-foot specimen came ashore at Ormond, Fla. It was described by Mr. B. A. Bean in SCIENCE, February 28, 1902. Its skin is now in the U. S. National Museum. A second specimen was taken at Knight's Key, Fla., in May, 1912. It was put on record by me in SCIENCE of August 22, 1913, and the fish and its capture were fully described by me in "Zoologica," *Scientific Contributions N. Y. Zool. Soc.*, March, 1915. Its mounted skin is in the possession of Captain Charles Thompson of Miami, Fla. The third, and, except the Abrolhos Light specimen, the only other definite record, is of a fish taken near Cape Sable, Fla., in June, 1919. This I have also put on record in SCIENCE for August 27, 1920. The indefinite record in the Atlantic, to which reference has been made, is found in George Bennett's "Wanderings in New South Wales, Batavia, Pedir Coast, Singapore and China," London, 1834. In Vol. II, p. 267, is a notice of a giant shark seen near the Azores in 1831. It was of great size, but too far off for spots and stripes to be seen, and while it was probably a *Rhineodon* it cannot be so stated definitely. Hence the specimen, referred to in the body of this article, constitutes our fourth definite record for the Atlantic Ocean.

E. W. GUDGER
AMERICAN MUSEUM OF NATURAL HISTORY

DISCHARGE OF STATIC ELECTRICITY

A SPLENDID example of the discharge of static electricity between two persons was witnessed at one of the games in the gymnasium of Iowa Wesleyan College at Mount Pleasant during the recent southeastern Iowa high school basketball tournament, and is reported by Ben H. Wilson, a member of the Iowa Academy of Science.

While the game was in progress between the Wayland and Ft. Madison teams, Saturday evening, March 11, 1922, two players in pursuit of the ball came together in the southeast corner of the court, after a fast run of almost half way down the length of the floor. A deep yellow spark was discharged between their bodies, the flash of which was plainly visible to spectators in the top row of the balcony in the northwest corner of the gymnasium, over one hundred feet distant. This could be no illusion as it was witnessed by over a dozen persons who made exclamation of the fact almost simultaneously. The spark appeared to be emitted at about knee height. Both players had on rubber-soled athletic shoes which would be non-conductors, and wore woolen shirts and cotton flappers. That this was visible in a well lighted room makes the phenomenon all the more remarkable.

Shocking the cat by rubbing the fur on its back; lighting the gas from a spark emitted from one's knuckle; witnessing sparks while combing one's hair in the dark; and children's shocking each other while playing on woolen carpets, are all quite common experiences, but this is the first time that the writer has heard of a similar occurrence being reported during an athletic contest.

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PARAFFINE PAPER SCREEN FOR SHOWING THE POSITION OF RETINAL IMAGE

UNDER the title, "The Inversion of the Retinal Image," Hartridge[1] refers to a statement by Senet[2] that the retinal image is not inverted. The former author then states that the evidence for that inversion is absolutely reliable and proceeds, in five paragraphs, to summarize the evidence on which the inversion of the retinal image is based. I quote his first two paragraphs:

"(1) If the eye ball of an albino animal be removed intact, and be mounted in a tube, so that while the rays from external objects enter the pupil, the posterior surface of the eye ball can be examined by an observer, then owing to the absence of pigment in the choroid the image formed on the retina is clearly visible. This image is seen to be inverted, top being at bottom and right being at left.

(2) In the case of an ordinary animal the choroid and sclera can with care be removed from the eye ball, leaving the retina *in situ;* observa-

[1] Hartridge, H.: Proc. of the Physiol. Soc., May 15, 1920, published in the *J. of Physiol.*, Vol. LIV, August 1920, p. 6.

[2] Senet: *Revista de la Universidad de Buenos Aires*, 41, p. 398, 1919.

tion of the retinal image shows that it is inverted and transposed.''

The experiments suggested here by Hartridge are well enough known, but his summary calls definitely to mind the fact that it is by the use of one or the other of these experiments that demonstration of the actual position and of the inversion of the image in the eye of a mammal must usually be presented to classes of students in physiology, whenever direct evidence is given at all. Difficulties often arise in carrying out either experiment. The eye of an albino as large as a rabbit is very often not easily obtainable. Since the eye of such an "ordinary animal" as the pig may almost always be had from the butcher or the meat market so soon after the animal has been killed that the dioptrical parts are still transparent, the ordinary eye would seem to be the obvious one to use for such demonstrations. As a matter of fact, however, the preparation of the demonstration with a pigment-bearing eye is rendered always somewhat uncertain, on account of the difficulty of removing the choroid and the retinal pigment without puncturing the retina and thus destroying its value as a screen on which to see the image. I have found it easy to complete the demonstration of the inverted image in such cases by carefully cutting out a little window of about 5 mm. diameter in the retina and then pressing over this window until it sticks fast against the vitreous humor a small piece of thin paraffine paper. Standing in the place of the retina, this paper forms a very good screen upon which to receive the image.

An incandescent electric light forms an excellent *object* for use in the demonstration, which is always an interesting one to students and certainly quite conclusive, as Hartridge says.

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QUOTATIONS

SPIRIT PHOTOGRAPHS

THERE is a society or club known as the Magic Circle which consists of professional conjurers, but admits a few approved amateurs, to the kindness of one of whom, a distinguished member of the medical profession, we are indebted for a copy of a report, dated May 31, issued by the Occult Committee of the Circle. This committee, which consists of expert conjurers, has been appointed to investigate what are called "spiritualistic phenomena," and at the suggestion of Sir Arthur Conan Doyle appears to have turned its attention first to spirit photographs. The report deals with the inquiries made by the committee into the claims of two people—a man and a woman—who it was alleged were producing spirit photographs of a remarkable nature in unopened packets of photographic plates. Neither of the mediums came out of the ordeal unscathed. When a fraud-proof packet was sent to the male operator he obtained no results. He stated that the packet had twice been "held," but that the "usual sensation" had not been felt. As soon, however, as a packet that could be tampered with was submitted, a "psychic extra," as it appears to be called, was obtained on one of the plates. Unfortunately for the performer the conjurers had tampered with the packet first. In addition to other tests, a straight line of red varnish (invisible in the red light of the dark room) had been painted across the top left side of the edge of the stack of six plates. On the return of the packet by the medium three of the red marks were found at the bottom, showing that these plates had been reversed. When the operator was asked for an assurance that the packet had really been returned unopened, he replied in the affirmative. He said that it was quite usual to get adverse remarks from persons who did not understand, and that such remarks were not worthy of notice. Shall we admire the power of spirits, or deplore the frailty of human nature? The lady medium was vouched for by Mr. and Mrs. Hewat McKenzie, who conduct an institution known as the British College of Psychic Science. Three sittings were held with this medium. First, two members of the committee secured a private sitting. It was required that the plates, enclosed in a sealed packet, should be sent for "magnetization" some days in advance, and at the sitting these plates were exposed, and on development "extras" were on

most of them. On one a face was visible in the midst of a cotton-wool effect; the others had crude markings, ascribed by the medium to unformed "ectoplasm" or to "spirit lights." As will be observed, she had acquired some of the latest spiritualistic terminology. At the second sitting, arranged by Mrs. McKenzie, a sealed box of six plates, forwarded in accordance with instructions, was produced by the medium. The box was opened and the plates transferred to metal dark slides; a service was then held, hymns being sung, and the Lord's Prayer recited. The plates were then exposed and an "extra" appeared on one of them—on No. 1 plate—which the investigators satisfied themselves had been substituted for the first plate of the original package. The medium had by this time become suspicious and nervous, and in fact she was not equal to holding her own with professional conjurers. She, however, consented to a third sitting, and for this an unopened box of unprepared plates was sent. It therefore became necessary that the plates should be secretly marked before being placed in the dark slides. One of the investigators, having placed the open stack of plates before the medium under the ruby light, secretly attached a small pad of pink material, chemically prepared, to the ball of his right thumb, and in handing the plates one by one to the medium an invisible mark was impressed on each. The medium gathered up the slides, and going into the studio took them to a small table on which her handbag was standing. The ostensible object was to obtain the hymn-books for the service, but the move being anticipated, the members of the deputation placed themselves in convenient positions to observe her actions. The hand holding the slides was seen to be placed inside the bag; one slide was dropped into a side pocket and a duplicate slide picked up with the hymn-books. Four plates were developed, and on one which did not show the mark a "spirit extra" appeared. All this may be amusing to the cynic, but the conclusions the committee of the Magic Circle draw are that although spirit photographers, like conjurers, meet changing conditions by the adoption of new methods, there are at present at least two methods in general use by some, at least, of the mediums who devote themselves to obtaining photographic "extras." In the one case, when the plates are accessible before the sitting, the spirit form is impressed, in advance, by contact with a selected transparency. In the other, when the packet is not available beforehand, the exchange for a prepared plate is made by a subtle move after the original plates have been loaded into the dark slides. The committee assert that they have never imposed a test which would not have served to demonstrate the straightforwardness and honesty of the medium, and conclude with a promise to extend to any honest medium fair, impartial and courteous treatment, and to give him a free hand to carry out the experiment in his own way.—*British Medical Journal.*

SCIENTIFIC BOOKS

The Evolution of Climates. By MARSDEN MANSON. 1922. *Published by the author.*

DR. MANSON has been long and widely known as a student of geologic climates. When his attention was first directed to the subject the currently accepted theory—which indeed still persists—postulated the solar control of terrestrial temperatures similar to that which now dominates such temperatures, but it early became apparent that not all of the problems presented could be satisfactorily solved under this assumption. For instance, the non-zonal distribution of climates such as certainly obtained during at least the major part of pre-Pleistocene time, the frequent recurrence of mild temperatures in polar areas, glaciation at or near sea level in and adjacent to the tropics, etc., have not been satisfactorily explained on the basis of exclusive solar control. This leads to the postulate of a dual heat supply—that is a part derived from the earth itself and a part from the sun. The manner in which this postulate works out and the solution it seems to afford to the various problems involved is set forth in the present paper.

In 1903 Dr. Manson published a preliminary paper under the same title as the present one, in which he reviewed the various theories that have been proposed to account for the origin and distribution of climatic differences, and

after practically twenty years of investigation, reading, and correspondence the present work can be considered as a summation of results. It is divided into three parts, the first of which sets forth the scope of the problem, while the second part deals with the application of the principles set forth to the facts of paleontology and geology, and the third to a recapitulation of conclusions and their general application.

Dr. Manson of course recognizes that on account of the low conductivity of the earth's crust it has been held by physicists and mathematicians that this source was inadequate as a factor of importance, but after reviewing the data on which this assumption is based he "feels obliged to reject the conclusions as 'incompetent, irrelevant, and immaterial'." He holds that "both earth heat and solar radiation prevailed as active factors in temperature control during all of the eras of geologic history and until the modern era of solar control; that the former was available as ocean stored heat, but the supply was held in the forming crust by reason of its low conductivity and was slowly made available by denudation and the exposures of radio-active materials, etc., or by periodic changes in the topographic form of the earth's surface which made increments of the interior sources of energy available."

This earth heat warmed the early oceans, the first effect being to increase evaporation and cloud formation. This ocean stored heat was conserved by the moist air and clouds and in part restored by the effects of solar radiation. This continued until the exhaustion of earth heat was registered by the cold oceans of Pleistocene time.

The causes for the initiation of glaciation as well as the alternation of glaciation and deglaciation or inter-glacial periods have given rise to almost endless speculation. Many students have stated frankly that they can see no possible or reasonable explanation of, for instance, the Permo-Carboniferous glaciation that occurred in or adjacent to the tropics, under direct solar control, and under this assumption this is about the only conclusion that can be reached. But Dr. Manson offers an explanation that is not only logical but seemingly possible not to say probable. He says: "The two conditions essential for glaciation are: (1) *Cold Continental Areas*—cold from more rapid chilling when remote from ocean influences, from elevation, from exposure to cold anti-cyclonic winds, and, upon the final loss of efficient earth heat; (2) *Warm Oceans,* to supply water vapor in sufficient amounts to deeply glaciate and to maintain continuous cloudiness to intercept solar energy."

"Land areas chilled prior to the oceans and were therefore exposed to glaciation. Furthermore in cooling oceans each of these impairments occurred at a critical temperature; first that degree which could just maintain cloud density in zones of minimum cloudiness; and lastly, that degree which could just maintain cloudiness in zones of maximum cloud density. Moreover, if, during the existence of either glaciation, the oceans should fluctuate in temperature to points somewhat above or somewhat below these critical temperatures, corresponding variations in the generation of water vapor would necessarily follow, imposing variations in the integrity of the cloud sphere in each latitude. Each fall below this critical temperature would impair the cloud sphere, and each rise above this temperature would restore it, thus alternately exposing the surface to solar energy and shutting off the same until the oceans again chilled below the critical temperature."

This in brief outline is Manson's explanation of the phenomena of glaciation and deglaciation. The theme is of course fully elaborated in the paper, and whatever its fate may be it is something that will have to be reckoned with by all future students. All will admit that any explanation that is put forward to account for glaciation or deglaciation must apply equally to these phenomena wherever they occur, and while many theories have been proposed that may seem to cover particular cases they fall short of accounting for all. Dr. Manson's explanation applies as well to the Huronian and Permo-Carboniferous as to the Pleistocene glaciation. It is a notable contribution.

F. H. KNOWLTON

SPECIAL ARTICLES

RECENT DISCOVERIES OF THE ANTIQUITY OF MAN

THIS paper is an abstract of two lines of research recently undertaken by the authors which will be published under the titles: "Old and New Standards of Pleistocene Division in Relation to the Prehistory of Man in Europe,"[1] "Pliocene (Tertiary) and Early Pleistocene (Quaternary) Mammalia of East Anglia, Great Britain, in Relation to the Appearance of Man."[2]

At the April, 1921, meeting of the National Academy, Dr. Osborn ventured the prediction that a large-brained type of man would be found in the Pliocene. He was not aware that such a discovery had actually been made in the Upper Pliocene Red Crag deposits near Ipswich, in the summer of 1921, because Mr. Moir's discovery of Red Crag and of sub-Red Crag man had not been accepted in England. It was not until an unmistakable human industrial level was found at Foxhall, near Ipswich, in the summer of 1921, that this locality was visited by the French archeologist, Breuil, who announced this important discovery at the Archeological Congress at Liége, in August, 1921. Dr. Osborn immediately planned to visit this locality and to make a careful survey and review of the animal life which surrounded Foxhall man. This review, fully set forth in both papers above named, shows that Foxhall man—capable of making ten or twelve different kinds of flint implements, of providing himself with clothing and of building a fire—sets an unmistakable Upper Pliocene date for the antiquity of man, in which he was surrounded by relatively primitive mastodons, rhinoceroses, saber-tooth tigers and two species of elephants, a fauna closely similar to the Upper Pliocene fauna of the valley of the Arno River, near Florence, Italy.

More recent than the Foxhall industry is that of Cromer on the coast of Norfolk, discovered during the summer of 1921. Cromer is also treated as of Upper Pliocene age by British archeologists, but it is unmistakably *Lower Pleistocene;* it belongs to First Interglacial time.

To establish this second point, Dr. Osborn enlisted the cooperation of Dr. Chester A. Reeds, beginning in the month of September, 1921, and undertook an exhaustive examination of the old and new standards of Pleistocene division in Europe, namely, of Geikie, Penck, Brückner and Leverett, ending with the recent work of Depéret and of De Geer. While these authorities do not agree as to causes or as to the duration of the Ice Age, a most important result of concurrent observation in England, France, Germany, Switzerland and North America is that there were certainly within the Ice Age four, and possibly five, distinct periods of glaciation, with at least four interglacial periods, all embraced within the Quaternary. British geologists and at least one French geologist, Marcellin Boule, include the First Glaciation within Tertiary time, but all the other authorities named above regard the First Glaciation as the opening of Quaternary time. The latter view is the one adopted by Osborn and Reeds and is clearly set forth in the synthetic diagram which summarizes our present knowledge of the geologic succession, of the industrial phases, and of the geologic appearance of human types. This table will be submitted to the coming International Congress of Geology at Brussels.

As a result of the researches summarized by the authors, we are now able to fix with considerable certainty the geologic level of the entire succession of human industries, namely, the Foxhallian, Cromerian, Chellean, Acheulean, Mousterian, Aurignacian, Solutrean, Magdalenian and Campignian. We are also able to fix with considerable exactitude the geologic age of the successive races of men, *i. e.,* Trinil, Piltdown, Heidelberg, Neanderthal and Cro-Magnon, which appear between Foxhallian and Magdalenian industrial times.

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[1] This paper, presented in abstract by Dr. Reeds before the Geological Society of America, is now in press in the *Proceedings* of the society.

[2] This paper by Dr. Osborn will appear in full in the *Geological Magazine,* London, 1922.

THE RECURRENCE OF ACUTE PARATHYROID TETANY IN COMPLETELY PARATHRYOIDECTOMIZED ANIMALS DURING THE OESTRUS CYCLE[1]

IN a previous communication Luckhardt and Rosenbloom[2] have shown that completely parathyroidectomized animals can be cured of all symptoms of tetany by the intravenous injection of Ringer's solution administered daily as indicated for a period of about forty days. After that period of time[3] the animals can be put on a meat diet limited in quantity only by their own choice and enjoy excellent health with no signs or symptoms of tetany except as noted.

Clinically it has been known for some time that some women who had been subjected to goiter operations suffered from tetany at each menstrual period. It was not clear, however, that the tetany was due to hypofunction of the parathyroid glands.

As is perhaps generally known, bitches go into "heat" about twice a year. At this time even normal dogs may show signs and symptoms which are indistinguishable from attacks of mild tetany occurring in parathyroidectomized animals. Anorexia, hyperpnoea, retching, vomiting, and mild fibrillations of the skeletal muscles are seen off and on particularly during the last week of œstrus.

It was therefore interesting to note what would happen during the œstrus period of bitches that had suffered a complete removal of all four parathyroids months previously.

We can present a report on two of such animals.

The one animal was completely thyroparathyroidectomized on October 23, 1921. All injections were stopped in January, 1922. From that time on the animal remained in splendid condition on a stock diet of meat, bread and bones. Tetany in very severe form was induced for the last time in February, 1922, by feeding the animal a large amount of meat mixed with barium sulphate. Mild tetany consisting of fibrillations of front and hind legs appeared spontaneously on ordinary diet on March 10, 11 and April 4, 1922. The dog was not depressed. The symptoms would be present one moment and absent the next hour only to recur several hours later together with a mild hyperpnoea. At these times the animals had a marked polydipsia. On April 9 an enlarged vulva and a distinct bloody vaginal discharge was first noticed. The tetany symptoms became more severe from day to day until on April 15 the animal had a severe tetanic seizure with depression, anorexia, hyperpnea, generalized fibrillations, clonic contraction of the temporal muscles (chattering), and a spasticity so marked that walking was difficult. Intravenous injections of Ringer's solution were freely given; and the animal was better on the following day. The tetany continued in more or less severe form until May 4. But even now (May 30, 1922) fibrillations of the neck and leg musculature can be seen now and then (perhaps because of early pregnancy).

The other animal was parathyroidectomized on January 29, 1922. Four days later the animal had depression, salivation, groaning, spasticity, tremors, clonic and tetanic convulsions. Indeed, artificial respiration had to be given because of a tetanic spasm of the diaphragm. As a result of the usual treatment the animal recovered. For a week or two it seemed doubtful whether the animal would survive. After that the general condition improved. Intravenous injections were discontinued on the forty-sixth day. The animal was exceptionally alert and playful. Its food (meat) consumption was not limited. On May 7, almost two months later, the vulva was noticeably enlarged. On the following day anorexia appeared. A fit of sneezing was followed by a spasm of the facial muscles. The ears were kept back; and the animal was greatly depressed. The condition became worse on the succeeding days. On May 12 retching and vomiting began. On the following day the animal was spastic. Fibrillations and clonic contractions were generalized but were especially noticeable in the temporal muscles.

[1] From the Hull Physiological Laboratory, the University of Chicago.

[2] Luckhardt and Rosenbloom: *Proc. Soc. Exp. Biol. and Med.*, XIX, No. 3, 1921, p. 129.

[3] Luckhardt and Rosenbloom: *Proc. Soc. Exp. Biol. and Med.*, this number.

Periodic spasms of the larynx and incessant vomiting continued for the next eight days. The generalized fibrillations gradually diminished in intensity but the clonic jerkings of the temporal muscles persisted together with anorexia and a marked depression. The gastric juice which was vomited up contained appreciable free and total acidity. Throughout this period intravenous injection of Ringer's and enemata were freely given. On May 20 the animal seemed decidedly better. Thereafter the condition gradually improved. At the time of writing (May 30) the animal is again free from all symptoms of tetany. All treatment was discontinued 14 days after the reappearance of the tetany.

In many respects the tetany appearing during the œstrus cycle of this animal was more severe than the tetany seen the first month following the parathyroidectomy.

We are in no position to explain the reoccurrence of the tetany with all its severity during the œstrus cycle months after the absense of any sign suggestive of tetany. The facts however seem to show that the tetany appearing in partially strumectomized women during menstruation is due primarily to hypofunction or absence of the parathyroids. As in previous work we observed during the tetany seizures signs pointing to a paresis of the sympathetic nervous system (enophthalmos), pseudoptosis, paretic nictitating membrane, bradycardia, conjunctival injection, general vasodilation, and a sluggish *atonic gastero-intestinal tract.* The latter condition (paralytic ileus) would favor the production of toxic products by bacterial action; the splanchnic dilatation (paresis of vasoconstrictor control) would permit of so rapid an absorption of these poisonous products that the liver would be functionally inadequate to neutralize them because of the speed of their delivery (alimentary toxemia). As in Eck fistula animals parathyroidectomized animals suffer from an intestinal toxemia. On this hypothesis the reported Ca deficiency in parathyroidectomized animals might well be an *effect* of the tetany condition rather than its *cause.*

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THE ALGEBRAIC METHOD OF BALANCING A CHEMICAL EQUATION

A CHEMICAL equation is said to be "balanced" when, for each element involved, the number of gram atoms in the left member of the equation is equal to the number of gram atoms in the right member. Given, then, the initial and final substances concerned in a chemical reaction, say

$$\alpha Ag_2AsO_4 + \beta Zn + \lambda H_2SO_4 = \delta AsH_3 + \varepsilon Ag + \zeta ZnSO_4 + \eta H_2O$$

"balancing" the equation consists in finding a set of values for α, β, λ, etc., such that the above named condition is fulfilled.

There are several methods of balancing a chemical equation. With simple equations the necessary coefficients are at once evident, or become so on brief application of the expedient of trial and error. In more complicated equations, however, the method of trial and error becomes tedious and other methods are convenient. In an oxidation-reduction reaction, consideration of the valence changes will usually give enough data to enable one to arrive at a solution of the problem, but this method is limited, even in application to such equations.

The algebraic method of balancing an equation is of general application and will be found time saving in dealing with complex equations. This method is outlined in a few of the textbooks, but is not in general use.

THE ALGEBRAIC METHOD

The ordinary method of balancing a chemical equation algebraically is a very simple procedure. In the following equation, let a, b, c, etc., represent the coefficients of the balanced equation:

$$aAg_2AsO_4 + bZn + cH_2SO_4 = dAsH_3 + eAg + fZnSO_4 + gH_2O$$

It is obvious that one may write algebraic equations expressing the number of gram atoms of each element involved in the reaction. Thus:

For silver: $2a = e$
For arsenic: $a = d$
For oxygen: $4a + 4c = 4f + g$
For zinc: $b = f$
For hydrogen: $2c = 3d + 2g$
For sulphur: $c = f$

Since this results in six equations amongst

seven unknowns, the value of each of the unknowns may readily be found in terms of any one of the unknowns, a numerical value being then assigned to the latter such that fractional coefficients will disappear. For example, from the six equations given above it follows that:

$$a = a \qquad e = 2a$$
$$b = \frac{11a}{2} \qquad f = \frac{11a}{2}$$
$$c = \frac{11a}{2} \qquad g = 4a$$
$$d = a$$

and calling $a = 2$, the chemical equation is:

$$2Ag_2AsO_4 + 11Zn + 11H_2SO_4 = 2AsH_3 + 4Ag + 11ZnSO_4 + 8H_2O.$$

NUMBER OF EQUATIONS AND NUMBER OF UNKNOWNS

In applying the algebraic method there may be written as many equations as there are elements concerned, and obviously there will be as many coefficients as there are compounds. Since the relation between number of equations and number of unknowns determines the applicability of the algebraic method, one is led to inquire into this matter with respect to the chemical equations ordinarily encountered. A random selection of fifty equations from an inorganic chemistry text-book reveals the following:

If x = number of elements concerned
y = number of compounds concerned

Then:

For 4 of the equations: $x = y + 1$ (Case I)
For 17 of the equations: $x = y$ (Case II)
For 28 of the equations: $x = y - 1$ (Case III)
For 1 of the equations: $x = y - 2$ (Case IV)

Since x independent equations fix every possible ratio between $x + 1$ unknowns, it is evident that in Cases I, II and III above the number of *independent* equations written will be one less than the number of unknowns, although the procedure of the algebraic method yields actually two additional (dependent) equations in Case I and one additional equation in Case II.

Case IV offers a curious condition, for here it is evident that the ratios between all the unknowns can not be fixed, and there may be found an infinite number of sets of coefficients which will balance the equation. The following equation is an example:

$$aKMnO_4 + bH_2SO_4 + cH_2O_2 = dK_2SO_4 + eMnSO_4 + fH_2O + gO_2.$$

The fact that this equation may be balanced in an infinite number of ways has no significance chemically, since the valence changes of manganese and oxygen settle the matter and there is only one set of coefficients which permit the equation to represent the chemical facts involved. In this case the valence changes involved require that $5a = 2c$ and this adds an additional equation to those required by stoichiometric considerations, and the problem of finding the coefficients falls then under Case III above. There are chemical equations, however, which can be balanced in an infinite number of ways having due regard for valence requirements. In the equation:

$$aK_2Cr_2O_7 + bH_2SO_4 + cFeSO_4 + dH_2S = eK_2SO_4 + fCr_2(SO_4)_3 + gFe_2(SO_4)_3 + hH_2O + iS$$

there are nine unknown coefficient and seven equations. Valence changes of chromium, iron and sulphur require that $6a = c + 2d$, but this equation is included in those required by stoichiometric ratios and the problem remains indeterminate. There will be $3a - 1$ true solutions for every value given a.

NUMBER OF ELEMENTS AND NUMBER OF COMPOUNDS IN A CHEMICAL REACTION

From a chemical standpoint, the fact that, with but few exceptions, x elements enter into reactions involving either x or $x + 1$ compounds may strike one as curious. Closer examination of this point, however, does not appear to reveal anything in the way of a law of nature, but indicates that the rule arises from certain limited values in the equations ordinarily used in inorganic chemistry, as is shown below:

Let x = Number of elements
y = Number of compounds
c = Total number of elementary symbols appearing
r = Unnecessary repetition of symbols (*i. e.*, in excess of $2x$).
k = Average number of elements per compound (*i. e.*, $\frac{c}{y}$)

Then for any chemical equation:

$$c = 2x + r$$

$$\frac{c}{y} \text{ or } k = \frac{2x}{y} + \frac{r}{y}$$

$ky - 2x = r$, which is an expression in which the difference between x and y is fixed by k and r.

The preponderance of binary and ternary compounds in inorganic chemistry, with occasional appearance of single elements would readily lead one to give k an average value in the neighborhood of 2.25. The actual average for k in the fifty equations referred to above is 2.285, the extreme values being 1.5 and 3.1.

The repetition of acid radicals in many of the reagents of inorganic chemistry, coupled with the fact that it is seldom possible to determine the products of a reaction amongst more than three substances, results in an average value of r, not far from that for k. Actual average for fifty equations is 2.44.

These average values for k and r require that the average value for x and y should not differ widely.

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THE IOWA ACADEMY OF SCIENCE

THE academy held its thirty-sixth annual session with Drake University, Des Moines, on Friday and Saturday, April 28 and 29. After a short business meeting President Morehouse gave his presidential address on "The cosmology of the universe." The academy then divided into sections for the reading of papers, and at six o'clock the sections met for dinners. In the evening President Edgar O. Lovett, of Rice Institute, Houston, Texas, gave the public address on "Some aspects of science." This address and the reception which followed were given at the splendid new municipal observatory, built by the city of Des Moines in one of its public parks and dedicated to Dr. Morehouse, the astronomer of Drake University. Opportunity was given the members for inspecting the equipment of the observatory and seeing the stars through the nine-inch telescope.

On Saturday morning the sections resumed their meetings, and at ten o'clock the academy convened to hear some papers of general interest. The following were elected as officers for the ensuing year:

President, R. B. Wylie, State University, Iowa City; *vice-president*, O. H. Smith, Cornell College, Mount Vernon; *secretary*, James H. Lees, Geological Survey, Des Moines; *treasurer*, A. O. Thomas, State University; *chairmen of sections: Botany*, H. S. Conard, Grinnell College, Grinnell; *chemistry*, Edward Bartow, State University; F. E. Brown, State College; *geology*, S. L. Galpin, State College, Ames; *mathematics*, C. W. Emmons, Simpson College, Indianola; *physics*, L. D. Weld, Coe College, Cedar Rapids; *zoology*, H. W. Norris, Grinnell College.

Resolutions were adopted favoring reforestation and conservation, and opposing the transfer of public forests to the Department of the Interior.

The following papers were presented:

ARCHEOLOGY

The new Albin inscribed tablet: ELLISON ORR.

Decorative markings on some fragments of Indian pottery from Mills County, Iowa: PAUL R. ROWE.

GEOLOGY

Recent studies of the Pleistocene in western Iowa: G. F. KAY.

Till-like deposits south of Kansas River in Douglas County, Kansas: WALTER H. SCHOEWE.

Status of sedimentation in Iowa: A. C. TROWBRIDGE.

Origin of limestone conglomerates: MISS LOUISE FILLMAN.

Classification of lenses: MISS LOUISE FILLMAN.

Notes on some mammalian remains reported in Iowa during the past year: A. O. THOMAS.

Records of Paleozoic glass-sponges in Iowa: A. O. THOMAS.

An Iowa Cambrian eurypterid: O. T. WALTER.

The Laramie hiatus in the southern Rockies: CHARLES KEYES.

Horizontal oblique faulting in inclined strata: CHARLES KEYES.

Taxonomic rank of Pennsylvanian grouping: CHARLES KEYES.

A deposit of pyrites in coal: JOHN M. LINDLY.

The deep well at Winfield: JOHN M. LINDLY.

The structure of the Fort Dodge beds: JAMES H. LEES.

The area near Stuart, Iowa: JOHN L. TILTON.

Some Black River brachiopods from the Mississippi Valley: CARROLL LANE FENTON and MILDRED ADAMS FENTON.

Oil prospects in Iowa: JOHN E. SMITH.

The Rockford geodes: SIDNEY L. GALPIN.

MATHEMATICS

IOWA SECTION, MATHEMATICAL ASSOCIATION OF AMERICA

The method of averages: G. W. SNEDECOR.

Mathematical bulletins: T. M. BLAKESLEE.

Topics in general analysis: E. W. CHITTENDEN.

The place of the equation in a scheme of education: C. W. WESTER.

Pre-symmetric determinants whose elements are finite sums: E. R. SMITH.

On the meaning of the classification of statistical series by means of the Lexis ratio: H. L. RIETZ.

Definitions of imaginary and complex numbers: E. S. ALLEN.

An extension of the figurate numbers: J. F. REILLY.

PHYSICS

A redetermination of the principal reflecting powers of isolated selenium crystals: L. P. SIEG.

Solubility and polarity: WILLIAM KUNERTH.

A comparison of intensities required under direct and under indirect lighting systems: WILLIAM KUNERTH.

Coefficients of diffusion of salt vapors in the Bunsen flame: GEORGE E. DAVIS.

The path of a rigid electron which moves in a magnetic field of constant strength rotating with constant angular velocity: E. O. HULBURT.

Phenomena in gases excited by radio frequency currents: E. O. HULBURT.

The broadening of the Balmer lines of hydrogen with pressure: E. O. HULBURT.

Nodal distances in acoustics: G. W. STEWART.

A variable single band acoustic filter: G. W. STEWART.

A new form of telephone receiver and transmitter: C. W. HEWLETT.

The scattering of X-rays by light elements: C. W. HEWLETT.

The attenuation factor in acoustic wave filters: H. B. PEACOCK.

The Hall effect and specific resistance of evaporated films of silver, copper and iron: J. C. STEINBERG.

Effect of automobile headlight lenses by box photometer method: D. M. SMITH.

ZOOLOGY

Iowa microlepidoptera: A. W. LINDSEY.

Brood "A" of the white grub extends its range in Iowa: H. E. JAQUES.

A study of the eggs of the white-marked tussock moth: MISS SUSANNAH POULTER and H. E. JAQUES.

A scribofacilograph for labelling kymographic tracings: T. L. PATTERSON.

Effects of stretch on smooth muscle responses: B. M. HARRISON.

Observations on the habits of a tarantula in captivity: ALBERT HARTZELL.

Some recently published errors respecting the cranial nerves of the dogfish: H. W. NORRIS.

Cranial nerve components in Amia, Lepidosteus, Polyodon and Scaphirhynchus: H. W. NORRIS.

Morphological studies on the injury to apple caused by Ceresa bubalis: J. C. GOODWIN and F. A. FENTON.

Some hereditary pathogens: W. E. SANDERS.

Some notes on Empoasca flaviscens: R. L. WEBSTER.

Simultaneous fast and slow drum records of fatigue: F. M. BALDWIN.

Nest-digging and egg-laying habits of Bell's turtle: FRANK A. STROMSTEN.

Notes on some of the rarer birds of the Ames region: H. E. EWING.

Bird records of the past two winters, 1920-1922, in the upper Missouri valley: T. C. STEPHENS.

Sociology as a science: HORNELL HART.

Chance in development as a cause of variation: P. W. WHITING.

Criteria of superior intelligence: REUEL H. SYLVESTER.

The mental and physical status of children entering the public schools: J. E. EVANS.

Behavior of trapped and banded birds: DAYTON STONER.

BOTANY

A comparative study of the common and red-seeded dandelions: MISS JUNE BERRY.

Some influences of the submarginal vein in leaves: ROBERT B. WYLIE.

The sperms of Vallisneria spiralis: ROBERT B. WYLIE.

Types of wound healing in certain foliage leaves: ROBERT B. WYLIE.

Morphology of the vein-islet in certain dicotyledons: SARA I. LEWIS.

Bud characters of native trees of Jasper County, Iowa: F. P. SIPE.

The American Lotus: L. H. PAMMEL.

Some observations on the plants of the Sierras: L. H. PAMMEL.